1.1 BACKGROUND OF PROGRAM ELEMENT

The Agricultural program element, Harvest the Rewards Program, is funded by SB 5X and provides incentives in the form of grants to the agricultural industry for efficiency and load management measures that reduce peak period electricity demand. The program also provides incentives for retrofitting equipment to burn alternative fuels. The total amount of funding awarded for this program element is $39.7 million. Additional contracts totaling $3.1 million were awarded for application assistance, program evaluation by Nexant, and marketing efforts. Goals for the Agricultural program element were initially set at 105 MW of peak period demand savings, and funding at $75 million. Funding for the program was revised to the current $39.7 million, with savings goals for the contract holders listed below at a total of 86.65 MW. The program is accepting project applications through December 31, 2003.

Major funding for the program element is distributed through two program administrators: the Center for Irrigation Technology (CIT), a division of the California Agricultural Technology Institute at California State University, Fresno; and the Irrigation Training and Research Center (ITRC) at California State University, San Luis Obispo.

The Energy Commission also administers direct contracts with the following organizations:

- Onsite Energy Corporation
- Inland Empire Utilities Agency
- Emeters
- San Diego Gas and Electric Company
- Southern California Edison
- Southern California Public Power Authority
- California Trade and Commerce Agency
- Western United Research Development, Inc.

Nexant is responsible for verifying the savings reported by the two administrators and by Onsite Energy Corporation. Nexant is not responsible for verifying the savings reported by Inland Empire Utilities Agency, but we do report on their project activity. Nexant is not responsible for the evaluation of the other six direct contractors, and their projects are not discussed in this report.

The two program administrators—CIT and ITRC—oversee the implementation of projects that fall into the following four program categories:

1. Purchase and installation of high efficiency electrical equipment and the implementation of load-shifting measures; also conversion of electrically powered agricultural pumps to natural gas engine-driven pumps.
2. Testing of the flow and efficiency of irrigation pumps and the retrofit or repair of such pumps.
3. Installation of advanced metering and telemetry systems that enable facilities to participate in emergency demand response programs.
4. Retrofit of natural gas powered equipment so that the equipment is capable of burning alternative fuels.

Under a direct contract with the Energy Commission, Onsite Energy Corporation has contracted to provide 8 MW of demand savings by implementing load reduction projects that target cooling and refrigeration or process loads. Also under direct contract with the Energy Commission, Inland Empire Utilities Agency will add 1.75 MW of generation capacity by implementing two biogas generation projects.

The Agricultural program element defines peak load reductions as the average load reduction during the hours from 12 p.m. to 6 p.m. on weekdays from June 1 to September 30.

1.2 STATUS OF PROGRAM ELEMENT

1.2.1 Snapshot of Element Status as of December 31, 2002

As of the December 31, 2002 Annual Report, the two independent administrators—CIT and ITRC—had approved applications for 837 projects representing a mix of demand savings and potential demand reductions totaling 78.9 MW.[1] The administrators at the time reported that 529 of these projects, representing 49.9 MW of peak load reductions, were complete. At that time, Nexant's verification of the reported savings was still ongoing, pending project completions and receipt of billing data for a full peak period.

Reports received from the two administrators now indicate a total demand savings of 66.0 MW verified from Category 1 and Category 3 projects, and projects implemented under the Onsite Energy Company contract. A total of 1818 individual projects have now been implemented under the three contracts for a total incentive grant amount of $13,068,590.

Table 1-1 summarizes the program activity of the two administrators, Onsite Energy Corporation, and Inland Empire Utilities Agency. The data presented in this table is from weekly updates provided by the administrators reports provided by Onsite Energy Corporation, and personal conversations with the Inland Empire Utility Agency project manager.

[1] Projects in category 1 (high efficiency equipment installations) result in sustained demand savings; projects in category 3 (metering and telemetry installations), however, result in *potential* demand reductions that are realized only during emergency electricity shortages. Projects in category 2 (pump repair and retrofit) may result in energy and demand savings, but savings are not being reported for such projects at this time. Retrofits that enable equipment to burn an alternative fuel do not result in demand savings, but they do provide facility owners some insulation from price fluctuations in the natural gas market.

Table 1-1: Program Status by Administrator and Project Type as of December 31, 2002

Administrator (or Contractor)	Project Type and Category	Approved Projects Number	Approved Projects Estimated Savings (MW)	Completed Projects Number	Completed Projects Reported Savings (MW)
Center for Irrigation Technology (CIT) Irrigation Technology Resource Center (ITRC)	High-efficiency equip. installation (1)	193	27.91	193	27.32
	Repair/retrofit of irrigation pumps (2)	747	NA	673	NA
	Metering/telemetry equip. installation (3)	18	50.22	18	29.93
	Retrofit of fuel-burning equipment (4)	20	NA	20	NA
[1]Inland Empire Utilities Agency	Generation	2	1.7	2	0.75
[2]Onsite Energy Corporation	Efficiency and load management	43	8.88	43[2]	8.80
Totals		**1023**	**88.71MW**	**1023**	**66.80MW**

[1]Demand Savings reported for Inland Empire Utilities Agency is not included in the Totals shown above.

[2]Onsite is limited to $2,000,000 in incentive payments. Some projects above the limit may be moved to another program.

Onsite Energy Company submitted final reports for several of their projects, including a multi site project for P&E Cold Storage in the fall of 2004. Demand savings were verified for each project based on the agreed method for M&V. The Onsite contract limits the grant incentive payments to a maximum of $2,000,000; due to the over-performance of some of the projects, Onsite may remove some projects from this contract and move them to another program.

The Inland Empire Utility Agency reported that installation and commissioning of their two bio-waste projects were completed in May 2002. The second phase of the project was predicted to result in increased generation of methane and generation capacity to 1.75 MW.

1.2.2 Project Completion Status

The two independent program administrators (CIT and ITRC) have pre-approved a total of 191 Category 1 projects (high efficiency equipment installations) with a total administrator verified demand savings of 27.32 MW. As of the last report from the CIT administrator, only 16 of the 18 projects were not verified for kW demand savings; many of these projects received late in 2003. Administrators have verified peak demand savings of 10.7 MW for completed Category 1 projects. In addition to the high efficiency electrical equipment projects reported under Category 1, ITRC has reported that two of the three natural gas engine projects were completed as of 12/31/03, the date of the last report update. The totals shown above include the two completed natural gas engine projects in the Category 1 totals for savings and incentive grants.

A total of eighteen Category 3 projects were approved with an estimated demand savings of 50.2 MW, the great majority of which was approved by the ITRC administrator. Final verification of the demand savings resulted in 29.93 MW in load reduction.

As of December 31, 2003 the two program administrators had stopped accepting new project applications, although the report from CIT does indicate a few were received in early January of 2004. Project totals shown in Table 1 above

The administrators reported that a total of 747 Category 2 projects (pump repair or retrofit) had been accepted by year-end. The 62 ITRC pre-approved grant applications are for water districts or agencies, many of which have multiple pumps under a single contract. A total of 72 individual pump repair or retrofit projects have been pre-approved by the ITRC administrator, but had not received final grant payments as of the 12/31/03 report. The CIT administrators more recent report indicates there are 16 of the 429 pump repair projects have not received final grant payments.

Of the original 57 Category 4 project submittals (retrofit of gas-burning equipment) CIT received during the early part of the program has resulted in 20 projects that have been completed. The relatively high rate of project withdrawals was likely due to financing difficulties and the price difference between other alternative fuels such as yellow grease and natural gas or both, especially during the 2001 and 2002 time-period when most of the Category 4 project submittals were received. The program was instituted during a peak in natural gas prices; the large drop in natural gas prices from June 2001 through 2003 is likely a significant factor leading to decisions to abandon alternative fuel projects.

Onsite Energy Corporation contracted directly with the Energy Commission to deliver 8 MW of peak period demand savings by delivering energy efficiency and load shifting projects at food processing facilities. As of October 2004 Onsite had completed 42 measures at 23 project sits. Nexant completed post-installation site inspections at each of the project sites for all of the measures. In some cases Nexant also performed pre-installation site inspections, but for the demand limiting system installations, only post-installation inspections were necessary. Based on individual project savings totals, Onsite Energy Company has completed a total of 8.12 MW of demand savings projects.

In December of 2001, Inland Empire Utility Agency completed installation of two biogas electrical generation projects. Phase I of the dairy waste methane-fueled generation projects are located at two sites--a converted domestic sewage digester at water recycling plant RP1, and at a groundwater desalter plant at the RP5 facility. A large manure digester tank is located a short distance from the desalter plant and provides methane gas for the two Waukesha engine generators and Capstone Microturbines at the desalter.

Phase I of the project was completed and fully commissioned at the RP5 facility in May 2002, and is now generating 0.5 MW. Mr. John Gundlach, the project manager for the Agency's Organics Management Strategy, confirmed that problems with initial start up had been corrected and methane production at the 1.2 million gallon digester tank was at design flow. Manure delivery from local dairies has now reached full subscription status, and the digester is producing an adequate supply of methane gas to fuel the Chino Desalter engine near the RP5 facility. The Waukesha internal combustion engine at the Desalter plant is capable of producing 1.5 MW, but the production of methane is not sufficient with one digester tank, and so natural gas is currently used to supplement methane production. Phase II of the project will add two additional digester tanks at RP5; once these are complete, methane production will be sufficient to generate 1.5 MW as indicated in the original Energy Commission award and demand savings goal. As of December 1, 2004, the agency has not commenced Phase II of the project.

The conversion of a domestic sewage digester to a dairy manure and bio-solids digester at the RP1 facility is also complete and, according to Mr. Gundlach, seven truckloads of manure per day are hauled from local dairies as feedstock for the digester. The project is producing enough methane to generate 0.25 MW for a combined production of 0.75 MW from the two projects. Ultimately, the utility district intends to run a combined biosolids/manure digester capable of producing enough methane to satisfy all of the electrical needs of the district, as well as market high grade composted material to the public.

1.3 MEASURMENT, VERIFICATION, AND EVALUATION APPROACH

Nexant's general approach to evaluating the program level savings is based on an evaluation of the administrators verified demand savings through a statistical sampling of the projects that were approved by the administrators. A representative sample of projects was chosen for analysis, and the findings from that sample were extrapolated to the population as a whole. The sample population was designed to be large and diverse enough to meet the statistical confidence and accuracy levels established as targets by the Energy Commission. The remainder of this Section 1.3 discusses Nexant's sampling and analytical methods in detail.

1.3.1 Sub-Population Designations and Sampling

Nexant has completed the program level evaluation of the Agriculture element. Time and budget constraints made it impractical to directly monitor and analyze the demand reduction (and as necessary, energy savings, e.g., Category 2 pump repair projects) of the entire population of projects in Categories 1 through 3. Therefore, the measurement, verification, and evaluation (MV&E) plan relied on statistically valid samples of projects within each category for inspection and evaluation of administrator verified savings claims. From the post-installation evaluations of the samples, Nexant infers the estimated demand reductions at all sites in Categories 1 and 3.

Nexant used stratified sampling techniques to identify a sample of projects that meet statistical precision and confidence guidelines for the program element. Effective use of stratified sampling depends on defining sub-populations that are relatively homogenous for a common parameter. Accordingly, Nexant drew random samples from homogenous strata within each project category, resulting in reduced overall variance for category level savings. Each category of project grants was treated separately, and within Category 1, Category 2, and Category 3, each category population is further segmented into relatively homogenous strata. A random sample of projects was selected from each category's strata for post-installation evaluation and verification.

The following paragraphs discuss the process and resulting samples, also listed below in Table 1-2 through Table 1-8.

Nexant's MV&E sampling plans are designed to meet the precision and confidence goals of the program; however, the actual statistics achieved through the MV&E efforts will not be known until post-installation monitoring and analysis of the sample projects are completed.

Equation 1, below is the formula used to calculate the sample size for a hypothetical infinite population of projects that follow criteria for normal distributions:

$$n^i = \frac{\lfloor C_v^2 \times z^2 \rfloor}{p^2} \tag{1}$$

Where:
n^i = sample size for an infinite population
C_v = Coefficient of variation (assumed to be 0.50 for sampling purposes)
Z = z-statistic (equal to 1.2817 for an 80% confidence level)
P = precision level (set at 20% for 80/20 reliability)

Previous experience with utility-sponsored DSM programs has shown that a starting value for the coefficient of variation of 0.5 is reasonable and conservative for a large variety of project technologies. With C_v set at 0.5, the sample size for a normally distributed, infinite population was found to be 11 from Equation 1 above.

None of the program categories has an infinite population of projects, of course, which requires compensatory adjustments to the sample size. The formula given in Equation 2 below is used to determine the sample size for a finite population of projects, and is used to adjust the sample sizes:

$$SampleSize = \frac{n^i}{\left[1 + \left(\frac{n^i}{N}\right)\right]} \tag{2}$$

The sampling formulas in Equation 1 and Equation 2 both apply to normal distributions. Sampling with these formulas assumes the populations are relatively similar in the parameters of interest. Approved projects from the two administrators are not similar in typical savings, technology type, and persistence of peak demand savings for Category 3 demand response projects; Category 4 projects do not have electrical savings.

To accommodate the heterogeneity of projects within program categories, sampling within each category of projects helps to ensure that each sub-population is closer to a normal distribution and results of sampling are statistically valid. This in turn ensures inferred sub-population demand savings are statistically valid within the target confidence level and precision interval.

Within each project category there are a wide range of savings and project technologies. A stratified sampling technique was used to identify the sample sizes for Category 1, Category 2, and Category 3. The technique is designed to improve the overall variance of the sampling efforts while reducing the sample sizes to a minimum. The stratified approach assigns sampling efforts for each of the strata in relation to the proportion of demand savings each individual stratum contributes to the overall category level demand savings.

A stratified sample calculator, developed for other energy savings programs by Nexant, was used to estimate the sample sizes for each project category and stratum. A spreadsheet of each of the Category 1, 2, and 3 sub-populations was characterized and populated for an appropriate number of strata for each project category. The defined stratum within each sub-population was examined for the number of approved projects and contribution to category level demand savings in kW; these were input to the calculator with an annual peak period operating total of 522 hours. The operating hours figure was derived from total number of summer peak period hours for this program element; however, the actual number is relatively unimportant – the number serves to reduce bias in the sampling. The resulting sample size for each category of projects is proportioned for each stratum within a sub-population according to its contribution to the project category's demand savings.

Sampling for Category 4 projects was treated in a slightly different manner—an Acceptable Quality Level (AQL) sampling approach was used to identify a representative sample of projects. The AQL sampling approach (ANSI/ASQC Z1.4) is based on sampling for an attribute, in this case the ability of the facility to switch to burning an alternative fuel, and applying the test results to the sub-population of Category 4 projects. If the number of sites that fail is less than the acceptance limit, the sample is accepted and the lot, or sub-population of Category 4 projects, is accepted as installed and presumed able to switch to alternative fuels.

Tables of AQL sample sizes are published for various precision levels. The 10 percent AQL table corresponds to a 20% precision interval, and for the sub-population of 20 approved projects, the sample size is three (3) for a double sample technique when all of the samples pass the test.[2].

For all project categories, after the stratified sample sizes were calculated, each project on a sub-population spreadsheet was assigned a random number from the Excel RAND function. All projects within each stratum were then sorted and ranked by their random numbers. The sample size for the corresponding stratum was next applied to identify the projects for post-installation evaluation. Each stratum of projects in Category 1, 2, and 3 was treated in the same manner. Projects for Category 4 were also identified using this approach; however, there was no initial stratification of the population. For Category 4 projects, the high number of projects that were withdrawn resulted in a significant reduction in the original sample size, as well as replacement of projects that were withdrawn for sampling purposes.

[2] An online AQL sample size calculator is available at: http://iew3.technion.ac.il/sqconline/milstd105.html

The following paragraphs describe the procedures used to identify post-installation samples from the four project categories and individual strata within the project categories. Projects for post-installation evaluation selected with the stratified calculator and random sampling are presented in Table 1-2 through Table 1-8. The entire list of approved projects from the two administrators and Onsite Energy Corporation can be found in the Appendices.

1.3.1.1 Sub-population—Category 1

Category 1 projects include a wide variety of technologies and range of demand savings estimates. The diversity of technology and demand savings in Category 1 approved projects and the need to keep the number of strata at a reasonably low level require that not all strata adhere to the ideal of homogeneity in either technology type or demand savings. In order to identify samples from strata with similar characteristics, five individual strata were defined and populated with projects approved by the two administrators.

Category 1 projects were allocated to the following strata:

1. Lighting efficiency and lighting controls
2. Motors, VFDs, and motor controls
3. HVAC and refrigeration
4. Reservoir improvements and TOU meters for load shifting
5. Drip irrigation conversions, new irrigation wells and booster pumps

Lighting projects of all types, including lighting efficiency, lighting controls, and skylights, have been grouped into the first Category 1 stratum. The second stratum is a broader grouping of motor efficiency, variable frequency drives (VFDs), automated controls and other measures involving installation of high efficiency electrical equipment. Refrigeration, HVAC, evaporative condensers, or other projects leading to refrigeration savings are grouped into the third stratum. The fourth stratum includes projects related to reservoir expansions, and time-of-use (TOU) meters that encourage facility owners to move operations to off peak hours. The fifth and final stratum for Category 1 projects includes conversion to drip irrigation, and irrigation pump equipment installations to offset peak period demand. Individual projects chosen from the five strata in Category 1 are shown in Table 1-2.

Table 1-2: Category 1 Stratified Samples

Stratum #	Stratum Name	Population in Stratum	Projects in Sample	Demand Reduction of Sample, kW
1	Lighting Efficiency/Controls	8	1	48
2	Motors/Drives/Controls	80	2	1,159
3	HVAC&R	29	2	683
4	Reservoir Improvement, TOU meters	40	6	386
5	Drip Irrigation, Boosters, Wells	19	1	45
Totals		168	12	2,320

Some of the approved Category 1 projects fall into multiple strata due to comprehensive retrofits at a facility; all measures for such projects are analyzed, and overall sampling will be revised to reflect the evaluation of the additional measures.

The 12 projects selected for post-installation evaluation are listed in Table 1-3. Each project is identified by its unique APLRP number and is listed in the order of the strata to which it was assigned.

Table 1-3: Category 1 Projects Selected for Post-Installation Evaluation

APLRP	Stratum #	Technology Description	Demand Savings, kW	Applicant
1-0378-A	1	DC Lighting efficiency retrofit	48	Blue Diamond Growers
1-0134-A	2	Comprehensive plant retrofit	1,029	Campbell Soup Company
1-0152-A	2	Power factor correction, lighting voltage reduction	129	Trinchero Family Estates
1-0404-A	3	Increased refrigeration coil capacity	29	Taylor Farms
1-0100-A	4	Lockouts for nursery circulation fans	9	Rote Greenhouses
1-0101E	4	Water pump time controls	168	Sierra View Farms
1-0351-A	4	Install TOU meters	47	Sandhu Bros. Farm
1-0367-A	4	Install TOU meters	2	Ewy Enterprises
1-0367-A	4	Install TOU meters	2	Ewy Enterprises
02-022-47310	4	Expand existing storage reservoir for off peak pumping	158	Belridge Water Storage District
01-269-A	5	Drip irrigation conversion	45	Silva Vineyards
Totals			2,320	

Note: One of the sampled projects that were evaluated by Nexant was later withdrawn, 01-0177-A.

1.3.1.2 Sub-population—Category 2

Category 2 project grants help pay for testing the efficiency and flow of pumps, with a second sub-category for repairing or retrofitting of the pumps. Pump repairs must be followed by a post-retrofit or repair test to establish a new efficiency and capacity point for the motor and pump system. Peak demand savings for the pump retrofit or repair projects are assumed to result from improved load management and by moving pumping energy to off peak hours. This strategy is appealing when combined with telemetry to remotely control pumping equipment while meeting irrigation or other water delivery needs.

Pump test projects are verified by the program administrators through a desk review of submitted documentation, as described on the program administrators' web sites. The grants are paid in full at the completion of the review and approval process. For purposes of program evaluation, these projects are ignored for post-installation inspections or monitoring. With no demand savings attributable to testing alone, there is little need to evaluate these projects for savings.

Peak period demand savings are not reported, and choosing a stratified sample of projects for post-installation evaluation requires a slightly modified approach. The two administrators offer incentives for pump repair projects through one of three options for calculating incentives. There are slight differences in each administrator's documentation and calculation of the project incentives; however, both administrators have comparable grant options, and all pump repair projects are grouped together by grant option.

There is a large sub-population of pump repair projects, with a current total of 590 individual pumps approved by the two administrators. Annual energy use was reported for the majority of the individual project sites for projects approved by the Fresno CIT administrator. CalPoly's ITRC administrator required the submittal of peak period billing from June through September, but has not yet provided energy use data for the projects in their database of approved projects.

Each of the projects was grouped by the grant option number on a spreadsheet for sample selection in four strata that are defined by the three grant options and an additional stratum for the projects paid at 65 percent of repair cost. Projects that had no reported annual energy use were assigned an energy use equal to the average of all other projects in the same grant option, with the exception of the projects that were approved at 65% of cost. The resulting sample sizes are proportioned according to the number of projects approved under each grant option, as well as the relative size of expected energy savings resulting from the pump repairs. Table 1-4 lists the four strata and sample sizes from the stratified calculator.

Table 1-4: Category 2 Stratified Samples

Stratum #	Stratum Name	Population in Stratum	Projects in Sample	Demand Reduction of Sample, kW*
1	Grant Option 1	80	2	6
2	Grant Option 2	33	1	18
3	Grant Option 3	309	8	77
4	65% of Cost	37	1	6
Total		459	12	107

*kW estimates are for sampling size calculations only. Annual kWh was divided by 2000 operating hours per year; with 8% savings assumed for pump repairs. Operating hours and savings rate suggested in utility study of irrigation pump repairs.

The selected projects in Table 1-5 were randomly selected from each of the four strata defined for Category 2 projects.

Table 1-5: Category 2 Projects Selected for Post-Installation Evaluation

APLRP*	Stratum #	Grant Option Description	Annual kWh Use	Applicant
02-0280-A	1	Change in plant operating efficiency	92,560	Tracy Ranch, Inc.
02-0369-A	1	Change in plant operating efficiency	63,633	E&M Dairy
02-0183-A	2	Change in kWh/AF from repairs	447,636	JG Boswell Co.
#27-D-10 #5	3	Grant paid at 25% of kWh	161,003	Delano-Earlimart Irrigation

APLRP*	Stratum #	Grant Option Description	Annual kWh Use	Applicant
				District
02-0266-A	3	Grant paid at 25% of kWh	26,736	A-G Sod Farms Inc.
#19-White #1	3	Grant paid at 25% of kWh	161,003	Reclamation District #548
#32-Area 18-10hp	3	Grant paid at 25% of kWh	161,003	Tulare Irrigation District
#34-C-82	3	Grant paid at 25% of kWh	161,003	James Irrigation District
#31-1R4.OD	3	Grant paid at 25% of kWh	161,003	Westlands Water District
02-0129-A	3	Grant paid at 25% of kWh	870,280	J.G. Boswell Co.
02-0333-A	3	Grant paid at 25% of kWh	217,520	M&C Farms
#13-Station B, Pump 2	4	Grant paid at 65% of cost, kWh use not provided	65% of cost	Cawelo Water District

* APLRP numbers preceded by "#" are from ITRC. The first number corresponds to water district application number for multiple site Category 2 projects.

1.3.1.3 Sub-population—Category 3

Technologies for Category 3 projects include installation of advanced metering and telemetry equipment for agricultural and water pumping load reduction strategies. Approved projects include increases in water storage capacity for load shifting, installation of interval metering for use with the ISO programs, and changes to pipeline systems to reduce head loss. Eleven of the eighteen approved Category 3 projects took part in the CAISO demand response program, and were required to shed load when an emergency signal was received from the CAISO. Two strata were defined for the sub-population: those projects with and those without a CAISO contract.

Projected kW demand reductions are not persistent throughout the summer peak season for projects with CAISO contracts, and the total kW is an estimate of *potential* demand savings if full subscription of an aggregator is achieved.

Table 1-6 lists the strata defined for Category 3 demand responsive projects and calculated sample sizes.

Table 1-6: Category 3 Stratified Samples

Stratum #	Stratum Name	Population in Stratum	Projects in Sample	Demand Reduction of Sample, kW
1	ISO Contracts	11	6	4,550
2	Non-ISO Contracts	7	1	425
Totals		18	7	4,975

Table 1-7 lists the randomly selected Category 3 project sites for post-installation evaluation.

Table 1-7: Category 3 Projects Selected for Post-Installation Evaluation

APLRP*	Stratum #	Project Description	kW Demand Reduction	Applicant
#01-020-47330	1	Interval meters for ISO program	1,000	Solano Irrigation District
03-0064-A	1	Install interval meters and telemetry equipment	1,595	Joseph Gallo Farms
#02-03-47330	1	Install 3 interval meters and telemetry for ISO contract	1,270	Natomas Central Mutual Water District
03-0112-A	1	Artesia Dairy ISO drip irrigation telemetry	450	Artesia Dairy
03-0113-A	1	Triangle-M Dairy ISO drip irrigation telemetry	100	Triangle-M Dairy
03-0118-A	1	Tevelde Dairy ISO drip irrigation telemetry	135	Ralph Tevelde Dairy
03-0095-A	2	Advanced metering/telemetry	425	Diamond D Dairy

*APLRP numbers preceded by "#" are from ITRC. The first number corresponds to the water district application number for multiple site Category 3 projects.

1.3.1.4 Sub-population—Category 4

Category 4 projects include retrofits to convert existing natural gas-powered equipment to burn alternative fuels. There are no kW demand savings for projects in Category 4, nor are the project applicants required to switch to full-time use of an alternative fuel. The test for completion of a project is the successful demonstration that the equipment is capable of burning an alternative fuel.

The post-installation inspection reporting will be based on whether or not the retrofit equipment can utilize an alternative fuel. The sample size calculation for Category 4 projects was based on principles from Acceptable Quality Level (AQL) sampling for attributes (equipment is installed and functional, or not). At the specified precision, the sample size was determined from an AQL table in correlation to the number of approved projects. The sample population to be inspected was then drawn randomly from the overall population without regard to cost of installation, grant amount, or possible natural gas savings from the project.

Based on the current population of 24 Category 4 projects, a sample of five sites was originally selected for inspection. Based on the double sampling technique for AQL sampling, a sample size of three is adequate provided none of the three had any failure (ie, had not been installed). All three projects were found to be installed and functional at the time of the post-installation inspection.

Table 1-8 lists the three randomly selected project sites for Category 4 sub-population post-installation evaluation. All Category 4 projects were submitted to CIT for evaluation and grant funding.

Table 1-8: Category 4 Projects Selected for Post-Installation Evaluation

APLRP #	Project Name	Project Description	Applicant
04-0003-A	Fresno poultry plant yellow grease project	Vegetable oil project proposal #2	J.G. Boswell Co.
04-0012-A	Del Mesa Porterville plant propane project	Cotton gins 2&3 – project proposal #3	J.G. Boswell Co.
04-0034-A	Del Mesa Feed Mill yellow grease project	Cotton gin #5 – project proposal #4	J.G. Boswell Co.

1.3.2 Savings Verification Methods

Using stratification and sampling techniques described above, Nexant selected samples of projects for post-installation evaluation of project savings for the different project-type strata within each program category. Each project in the samples is subjected to post-installation evaluation, and the results are used to extrapolate to the peak period demand savings for each stratum and program category. With the differences in savings types between projects in Category 1 projects (energy efficiency) and Category 3 projects (load shifting and peak clipping), the lack of savings from Category 4 projects (fuel substitution), and unreported savings in Category 2, combining all results into program level demand savings as a single number is difficult and somewhat misleading. Nonetheless, determining a statistically valid estimate of savings from each of the categories of projects is the fundamental goal of the evaluation efforts.

Nexant's savings verification efforts include a variety of methods to estimate baseline demands and document project savings. In general, the approach is based on the M&V methods established for each project by the project sponsor and approved by the program administrator. Nexant attempts to follow the administrator's methods of baseline determination and performance measurement during the independent verification of project savings. When Nexant is not satisfied that the administrator methods were rigorous enough, or when access to monitoring data or power measurements is available, those results are incorporated into the analysis of baseline and savings verification reports.

1.3.2.1 Category 1 Verification Methods and Examples

Electrical efficiency projects in Category 1 were evaluated by the administrators for baseline demand—in most cases through analysis of utility billing data along with evaluation of project descriptions, equipment descriptions and nameplate information, and operating profiles. However, the Category 1 projects have significant diversity, and methods for verification of savings vary accordingly.

Nexant's post-installation evaluation approach of the Fresno administrator project #0101-E (Sierra View Farms), for example, was selected for evaluation. The project included installation of time management controls for a 75 hp turbine pump. Since a TOU utility meter that records peak period energy serves the pump, verification of both baseline and post-installation energy use for this project is possible through utility billing. A comparison of recorded baseline and post-installation energy use during peak period hours easily yields the average demand savings for the project.

An example of another more complicated project in the sample of Category 1 projects is the Campbell Soup Supply Company project in Dixon. The Fresno administrator project, #01-0134-A, is a project to replace approximately 1,850 hp of electric-driven evaporator motors with steam-driven motors, as well as heat exchangers and other equipment to reduce plant electrical loads. This project cannot be verified through post-installation monitoring equipment, as the motors have been removed. Instead, the entire plant utility billing before and after the project for summer peak periods is used to verify that the savings are accurate. Any increases or decreases in plant production may influence the summer peak period savings; therefore, a review of the plant's production covering the baseline and post-installation summer peak period billings is also required to evaluate the savings. If production has changed, the electrical use and savings will be evaluated on the basis of normalized production volume.

Onsite Energy Corporation's project from Pacific Coast Producers in Woodland included a complete replacement of the existing tomato processing plant in Lodi with a modernized plant in Woodland. Pacific Coast Producers wanted to move closer to the source of the tomatoes used in their products, improve the overall plant efficiency, and increase the plant's production. Robert Mowris & Associates completed a detailed piece-by-piece evaluation of the new plant's equipment and expected peak period demand improvements as well as annual energy savings for Pacific Coast Producers. With production expected to increase approximately 30% compared to the Lodi plant, straight comparison of utility billing data would have resulted in a very low level of savings. If individual equipment loads were evaluated against the new equipment, a similar savings level may have resulted; however, the propagation of uncertainty in evaluation of savings for each piece of equipment would not provide the necessary confidence in the results of the evaluation.

Robert Mowris instead evaluated the existing plant's electrical billing data and production data to establish a measurement of energy and demand per unit production. The same process was completed during the first summer of operation in 2002 for the Woodland plant. To recognize the improvements in efficiency, the difference in kWh per unit was calculated for the two plants, and then multiplied by the existing production at the Lodi plant. The resulting kWh savings were then divided by 504 hours, the length of the 2002 summer peak season to establish the average peak period demand savings for the new plant based on production levels at the Lodi plant.

In another Onsite Energy Corporation project, the project sponsor has been continuously monitoring the system's baseline conditions in an ammonia refrigeration plant for two years, made possible as a result of a previous Standard Performance Contract program at the plant. The addition of a monitoring power meter for a new compressor allowed Onsite to verify demand savings to a high level of accuracy, despite changes in operation at the plant due to increased production. Similar to their project at Woodland, by evaluating energy use per unit of production, the project savings will be normalized to the baseline production level. In this example, the method includes direct monitoring of the refrigeration compressors, pumps, and evaporative condenser fans and pumps. Nexant independently analyzes monitored data to verify reported savings of the project.

1.3.2.2 Category 2 Verification Methods

Category 2 projects are a much more difficult class of projects for verifying any peak demand savings. Pump repair or retrofit projects might lead to energy and peak period demand savings, *provided that* the peak period operation of the pumps is reduced as a result of an increase in pumping capacity. For TOU-metered pumps, recorded data from baseline and post-installation periods readily establish the basis for calculating average peak demand savings. It would appear to be convenient to use monitored data from TOU-meter equipped pumps as a basis for extrapolating to the entire population of pump repair and retrofit projects, yet this would not be a valid extrapolation of savings data. (In practice, if a pump is not equipped with a TOU meter, the irrigator has little reason to shift pumping hours to off-peak times, and so the non-TOU-metered population is atypical). In other cases, an irrigator may not be able to shift hours, but has been unable to provide sufficient irrigation without the pump repairs partially funded through this program. This potential problem is discussed in more detail below in Section 1.5.1.

1.3.2.3 Category 3 Verification Methods

Verification of project savings for Category 3 projects is typically accomplished through utility billing records of peak period energy use, and for a few of the projects, documented tests of load shedding for electrical emergencies. Projects in Category 3 are equipped with TOU meters, and evaluation of peak period energy savings is accomplished through a comparison of pre-installation and post-installation utility billing records.

1.3.2.4 Category 4 Verification Methods

Verification of Category 4 projects consists solely of visual inspection of equipment installations and their ability to utilize alternative fuels. No peak period savings result from installation of the equipment for these projects.

1.4 PROGRAM ELEMENT MONITORING AND VERIFICATION

1.4.1 Review of Sampling Status

Table 1-9 summarizes the sample size information for the four project categories as submitted in sampling plans developed during the second and third quarters of the year. The total sample sizes in the table were based on a stratified sampling methodology that focused on where the greatest demand savings are to be found. The overall sample kW identified for each project category was calculated for the population based on the estimated demand savings, such that each category's sample size will meet the program’s statistical criteria of an 80 percent confidence around a 20 percent precision interval (80/20). Within each of the four project categories, samples have been drawn in proportion to the individual strata defined for various project technologies or M&V.

Table 1-9: Post-Installation Verification Sample Sizes as of December 31, 2002

Project Type/Contractor	Approved Projects	Sample Size
Category 1	194	12
Category 2	747	12
Category 3	18	7
Category 4	20	3
Onsite Energy Corporation	42	All
Inland Empire Utilities Agency	2	N/A

1.4.2 Inspected Projects by Project type

Projects reviewed and contracted by the two administrators were not visited prior to installation of proposed equipment. All baseline demands were estimated and approved by the administrators through a combination of techniques. Nexant did not participate in the process.

Nexant has completed site visits to the sample of Category 1 project sites to verify equipment installations and for evaluation of project savings. Category 2 and Category 3 sites were not visited as determination of project completion for these types of projects was determined to be unnecessary.

Nexant has completed pre-installation for many, and post-installation inspections for all of the Onsite Energy Corporation projects at food processing and cold storage facilities. All of Onsite Energy Corporation's projects are similar to Category 1 projects and feature installation of electrical efficiency equipment and load management controls. Baseline peak period loads have been verified through a combination of techniques including billing histories, pre-installation spot measurements of equipment, auditing of lighting equipment, or monitoring data from previous energy efficiency projects at a facility.

Post-installation inspections have also been completed for all of the Onsite Energy Corporation project sites with completed measure installations. Onsite Energy Corporation in most cases has installed their own monitoring equipment to record peak period energy and demand use, although they have also used consultants to develop the measured savings for a comprehensive plant retrofit in Woodland.

Post-installation inspections for three Category 4 sample projects have been completed. Nexant verified equipment installations and that the equipment was capable of burning an alternative fuel. Original sample size for this category was set at 8, however, due the smaller final population of Category 4 projects, and 100% inspection passes, only three sites were visited for evaluation of these projects.

1.4.3 Projects Inspections

Table 1-10 shows project inspections, project savings for completed measures, and findings based on inspection results, or other data reviews.

Table 1-10: Inspected Sites and Summary Findings

Administrator	Project Name	Location	Project Size	Findings
Category 1 Projects				
Onsite Energy Corporation	Gatorade	Oakland	61	VSD equipped Compressor, blower powered air knives, modified distribution system.
Onsite Energy Corporation	Pacific Coast Producers	Woodland	1,464	Plant wide retrofit and relocation of existing processing plant from Lodi to Woodland. Some adjustment to savings total.
Onsite Energy Corporation	Del Monte Hanford	Hanford	90	Remove four 40hp water pumps for flume system.
Onsite Energy Corporation	Del Monte Hanford	Hanford	179	Replace water based flume tomato handling system with right sized motor driven belt type conveyor system
Onsite Energy Corporation	Del Monte Hanford	Hanford	215	Plant-wide retrofit including hydraulic motor to electric conversion, removal of hydraulic pumps, water flume replacement, high-speed Fenco pulpers, cooling water controls for evaporators are all complete; data for 2002 peak season not yet received
Onsite Energy Corporation	Del Monte Hanford	Hanford	112	Replace Manzini pulpers with Fenco units – higher energy efficiency and throughput
Onsite Energy Corporation	Del Monte Hanford	Hanford	39	Water pump controls to allow shut down during times when only one of the evaporators is in use – approx. 900 hours per season.
Onsite Energy Corporation	Frito Lay, Visalia	Visalia	76	VFDs for boiler feedwater pump (100 hp), and FD fan for boiler (75hp)
Onsite Energy Corporation	Frito Lay, Visalia	Visalia	5	Install 20 power planner, power wave modification equipment
Onsite Energy Corporation	Frito Lay, Visalia	Visalia	29	Replace 16 1.5hp vacuum caser motors with central system
Onsite Energy Corporation	Frito Lay, Visalia	Visalia	140	Expander controls on existing plant air system to eliminate one of electric air compressors
Onsite Energy Corporation	Frito Lay, Visalia	Visalia	115	Replace remaining electric driven air compressor for plant air with nat. gas driven Kaeser compressor
Onsite Energy Corporation	Frito Lay, Visalia	Visalia	127	Install Solatube skylighting for manufacturing floor and office areas
Onsite Energy Corporation	Frito Lay, Visalia	Visalia	160	Install PowerIT Demand limiting system for plant loads
Onsite Energy Corporation	Frito Lay, Modesto	Modesto	146	Installation of 100 Hp VFD compressor will allow shut down of one 250 Hp unit.
Onsite Energy Corporation	Frito Lay, Modesto	Modesto	34	Installed VFDs for pumps in boiler room.
Onsite Energy Corporation	Frito Lay, Modesto	Modesto	350	Installed PowerIT Demand limiting system for plant loads
Onsite Energy Corporation	Frito Lay, Modesto	Modesto	17	Installed Mytech bi-level HID controls for warehouse lighting and skylight/dayligting
Onsite Energy	Frito Lay	Rancho	350	Install PowerIT Demand limiting system for plant loads

Administrator	Project Name	Location	Project Size	Findings
Corporation	Rancho Cucamunga	Cucamunga		
Onsite Energy Corporation	Leprino Foods	Tracy	500	Reduced condenser head pressure from 180 to 155 psig
Onsite Energy Corporation	Leprino Foods	Tracy		Installed new heat exchangers, split brine system
Onsite Energy Corporation	Dreisbach Lighting Controls	Richmond	29	Installed motion detectors and bi-level lighting on existing HID fixtures
Onsite Energy Corporation	Dreisbach Lighting Controls	Oakland	25	Installed motion detectors and bi-level lighting on existing HID fixtures
Onsite Energy Corporation	Dreisbach Lighting Controls	Moss Landing	26	Installed motion detectors and bi-level lighting on existing HID fixtures
Onsite Energy Corporation	Dreisbach Demand Limiting System	Richmond	-	Installed demand limiting system
Onsite Energy Corporation	Dreisbach Demand Limiting System	Oakland	339	Installed demand limiting system
Onsite Energy Corporation	Dreisbach Demand Limiting System	Moss Landing	112	Installed demand limiting system
Onsite Energy Corporation	Del Mar Foods, Watsonville, Plant Side	Watsonville	399	Installed demand limiting system
Onsite Energy Corporation	Del Mar Foods, Watsonville, Cold Storage Rooms	Watsonville	143	Installed demand limiting system
Onsite Energy Corporation	Bonita Pak Foods	Santa Maria	843	Installed demand limiting system
Onsite Energy Corporation	Cool Pacific Foods	Salinas	208	Installed demand limiting system
Onsite Energy Corporation	Richmond Wholesale	Richmond		Installed demand limiting system
Onsite Energy Corporation	P&O Cold Logistics - Vernon #1	Vernon	441	Installed demand limiting system
Onsite Energy Corporation	P&O Cold Logistics - Vernon #2	Vernon	157	Installed demand limiting system

Administrator	Project Name	Location	Project Size	Findings
Onsite Energy Corporation	P&O Cold Logistics - City of Industry #4	City of Industry	441	Installed demand limiting system
Onsite Energy Corporation	P&O Cold Logistics - Dominquez Hills #6	Dominquez Hills	44	Installed demand limiting system
Onsite Energy Corporation	P&O Cold Logistics - Carson #10	Carson	196	Installed demand limiting system
Onsite Energy Corporation	P&O Cold Logistics - Anaheim#11	Anaheim	102	Installed demand limiting system
Onsite Energy Corporation	P&O Cold Logistics - La Habra #13	La Habra	114	Installed demand limiting system
Onsite Energy Corporation	P&O Cold Logistics - Brea #14	Brea	97	Installed demand limiting system
Onsite Energy Corporation	P&O Cold Logistics - Modesto #15	Modesto	198	Installed demand limiting system
Onsite Energy Corporation	P&O Cold Logistics - Salinas #18	Salinas	62	Installed demand limiting system
CSU, Fresno	Rote Greenhous es		9	Installed lockouts for nursery circulation fans
CSU, Fresno	Sierra View Farms		168	Water pump time controls
CSU, Fresno	Campbell Soup Company		1,029	Completed a comprehensive plant retrofit
CSU, Fresno	Trinchero Family Estates		129	Power factor correction, lighting voltage reduction with autotransformers
CSU, Fresno	Silva Vineyards		45	Replace overhead sprinkler system with drip irrigation conversion
CSU, Fresno	Sandhu Bros. Farm		47	Installed a TOU meter for irrigation pumps
CSU, Fresno	Ewy Enterprises		2	Install TOU meter for irrigation pumps
CSU, Fresno	Ewy Enterprises		2	Install TOU meter for irrigation pumps
CSU, Fresno	Blue Diamond		48	Retrofit a High Bay HID system with lower wattage Metal Halide system

Administrator	Project Name	Location	Project Size	Findings
	Growers			
CSU, Fresno	Taylor Farms		29	Increased refrigeration coil capacity
Cal Poly	Belridge Water Storage District		0	Project proposal was to expand an existing reservoir to allow for off peak pumping; the project was not completed due to district financial issues.
Category 4 projects				
CSU, Fresno	Central Valley Coop.	Hanford	N/A	Conversion to Propane for Dual Fuel; all equipment verified
CSU, Fresno	Lone Star Dehydrator	Sanger	N/A	Propane fuel system installed as backup for natural gas
CSU, Fresno	Six Jewels	Fresno	N/A	Ag. Fruit Dehydrator Retrofitted from Natural Gas

1.5 PROGRAM ELEMENT EVALUATION

1.5.1 Evaluation Results

Nexant has completed desk-based reviews of Category 1 and Category 3 projects identified in the sampling plan, and has conducted post-installation inspections and project evaluations for Onsite Energy Corporation projects.

Nexant has completed desk-based reviews of Category 1 applications, billing statements and other documentation provided by the two independent administrators. During this review, Nexant analyzed assumptions, calculations, and billing data used to estimate baselines and demand savings. Nexant's analysis suggests a slightly lower peak period savings total than approved by the administrators, with a realization rate of 89 percent for the sample projects. Nexant has completed field verifications for most of the Category 1 projects in the sample list, although the Belridge Storage District project was cancelled

For one of the sample projects, Nexant conducted post-installation site visits to three of Trinchero Family Estates facilities. Spot measurements of equipment loads were recorded for a sample of the motor and lighting equipment at the three wine industry facilities. Nexant's evaluation of peak period demand savings for the power factor correction and lighting system voltage controls resulted in a recommendation to the Fresno administrator for approval of the project, although with significantly lower savings. The application estimate of 726 kW peak period demand savings was rejected as unrealistic. Nexant revised the savings estimate based on a model of improved power factor savings from reduced I^2R losses and post-installation measurements of equipment at the facilities during the post-installation inspections. The project has not yet been approved or verified by the Fresno administrator, and no payments for the project have been made to date.

Nexant also participated in a post-installation review of demand savings for several projects at the request of the Fresno administrator, including Puritan Ice, and four projects approved for Frito Lay, Bakersfield. Nexant has not visited the sites for these project evaluations, but instead reviewed the application, billing history, and administrator-approved M&V plans. The Puritan Ice project, # 01-0177-A was originally part of Nexant's post-installation evaluation sample, but was withdrawn from the program and replaced by another project for sampling.

In December 2002, the Fresno administrator requested assistance from Nexant for evaluation of demand savings claims based on approved M&V plans for four separate projects at Frito Lay, Bakersfield. Each of the four electrical efficiency projects would be expected to deliver the peak period demand savings claimed in the original applications. However, the plant has a large cogeneration facility that meets the majority of the plant's electricity needs during the summer peak period. Nexant's review of the four projects was outlined in a memo to the Energy Commission and the Fresno administrator. In the review, Nexant pointed out that the M&V approach for each of the projects was based on utility billing data that, in all but one case, failed to support claims for peak period demand savings. In addition, Nexant found that savings claims for the only project for which the contracted grant amounts may be paid were also questionable depending on the choice of the baseline year of utility billing data; the M&V plan was unclear on the year to be used for comparison purposes.

Although none of the four individual projects at the Frito Lay, Bakersfield plant was identified as part of the post-installation random sample for Category 1 projects, Nexant believes the problems associated with the Fresno administrator's approval and payment for these projects is illustrative of problems that can and did occasionally occur while conducting a large scale incentive-based program such as the APLRP. Careful review of the M&V plans for each of the four projects shows that even if the cogeneration facility had not been a factor, demand savings for three of the four projects would have been difficult to determine. Nexant found that for each project, post-installation evaluation of demand savings were questionable with unclear definitions of project baselines, and post-installation validation of savings through peak period utility billing data affected by subsequent project activities.

Evaluation of peak period savings for Category 2 pump repair or retrofit projects has not been completed, nor can it be given the operations of irrigation pumps. To date, administrators have not reported demand savings estimates for the projects. However, the cumulative impact of the 747 pump repair projects for long-term energy and peak period demand savings is an important unknown. Although peak period savings are not reported, Nexant has analyzed pump test data reported by the Fresno administrator and performed a scenario analysis on a relatively large sample of the projects to estimate a potential range of possible peak period demand savings.

Any method used to estimate peak demand savings for an individual pump repair must begin with some basic assumptions regarding effects of the repair(s) on a pump's post-installation operation. When a pump repair is completed, the Operating Plant Efficiency (OPE) for that pump and distribution system increases. Conrad, Weisbrod, and Samiullah,[3] in a 1999 paper summarizing pump testing efficiency results for thousands of Southern California Edison pump tests, noted that average OPE for a typical turbine pump can be increased from 40 to 68 percent by reducing losses in the bowl assembly, column and shaft, and motor bearings. Overall plant efficiencies as high as 72 percent can be achieved with pumps in the 300 hp range.

From an irrigator's perspective, a repaired well, booster, or surface water pump provides a range of economic benefits including more reliable irrigation equipment, increased flow rate at design delivery pressures, and shorter irrigation intervals for a fixed volume of water pumped. If the baseline condition and efficiency for a pump system is poor, improvements resulting from the pump system repair generally leads to increases in the motor's electrical demand, flow rate, possibly head pressure, or a combination of the three. With an increase in flow from a pump, an irrigator has choices including increasing the area irrigated by the pump during each irrigation set, reducing the interval over which irrigation of the field takes place, or continuing to operate as before—however, with an increased rate of delivery of water to a field.

When the size of an irrigation set is increased, or the irrigation time decreased, the energy use of a pump should decrease relative to the baseline energy use prior to the pump retrofit and repair. Irrigators who are on voluntary time-of-use rates might be expected to reduce irrigation times during the highest-cost peak periods of the summer due to high costs of on-peak irrigation. However, if an irrigator fails to shorten the time intervals for the irrigation schedule, or increases the size of the irrigation set relative to the baseline conditions, the improved pump system may use more energy -despite the improvement in efficiency from pump repairs and retrofits. Even with an improved Operating Plant Efficiency, if the volume of water delivered increases as a result of the project, overall electrical energy use can increase, resulting in little to perhaps negative average peak period demand savings. An irrigator will have to absorb higher electrical costs, but potential benefits that could outweigh energy savings include an improvement in crop yield, quality, or both from the increased amount of water delivered to a field.

To make a reasonable estimate of energy and demand savings from pump repairs, a critical assumption must be made—an increase in OPE for a pump system allows an irrigator to shorten the time interval or the size of an irrigation set to pump the same volume of water on a seasonal basis to a field, and the irrigator is not going to increase the total volume that is delivered to a field. If an irrigator chooses not to reduce the irrigation schedules, or continues to irrigate with the same set size and schedule, the improvement in pump efficiency will, in many cases, result in increased energy use and peak period demand due to a seasonal increase in water delivery to the field and higher input power requirements to the pump[4].

The Fresno administrator database reports include details of pump repairs and retrofits that are useful for analyzing potential energy and demand savings. Included in the reported data are

[3] Thomas Conlon, GeoPraxis, Inc., Glen Wisbrod, Economic Development Research Group, Shahana Samiullah, Southern California Edison, "We've Been Testing Water Pumps for Years – Has Their Efficiency Changed?" April 1999, subsequently published in Proceedings of the 1999 ACEEE Summer Study of Energy Efficiency In Industry

[4] Hanson, Blaine R., "Improving Pumping Plant Efficiency Does not Always Save Energy", California Agriculture, July-August, 2002, 123-127.

listings of the pre-installation energy usage for each pump over the preceding 12 month period, and results of OPE tests for many of the pumps. Nexant sorted the data for all pump repair projects with reported pre-retrofit and post-retrofit OPE tests. From this subset of pump repair projects, information about OPE improvements was calculated for the subset, and then extrapolated to the population.

For the 228 pump repair projects in the Fresno database with both pre-retrofit and post-retrofit OPE tests, the average improvement was 92 percent; increasing approximately 24% from an average of 39 percent pre-retrofit to an average of 63 percent after repairs and retrofits. The OPE improvements are consistent with the potential improvement suggested for a typical turbine pump, although both the baseline and post-retrofit efficiencies were somewhat lower than reported in the long term testing programs conducted by Southern California Edison.

Assuming that each pump operated at or near full load while in operation, the average annual hours of operation for the average sized pump in the subset of data was calculated at 2,967 hours based on an average 12 month electrical use of 187,000 kWh, and average pump size of 101 hp. Assuming a motor loading of 80 percent, and average motor efficiency of 89 percent, the pre-installation demand for each pump would have been approximately 67.9 kW. As calculated, the average annual pump hours exceeds the total number of hours (2,978 hours) in an assumed 4-month irrigation season of June through September, including 504 summer peak period hours.

Again emphasizing the assumption that the seasonal volume of water pumped to a field is constant after pump repairs, an efficiency savings per pump of approximately 45,700 kWh per year could be expected based on average OPE improvements. Following through with the analysis, if all energy savings from OPE improvements are assumed to occur during the summer peak period by turning pumps off, the average number of hours that can be offset is greater than the full summer peak period. For the extreme case where it is assumed that all pumps are on time-of-use utility rates, and that all operational changes are reductions in peak period pumping, the change in average OPE for the entire population of pumps could result in up to 47 MW of peak period demand savings for all pump repair projects approved for the program.

As repeatedly noted, any energy or demand savings that might be attributed to the repair of agricultural pumps must be accompanied by a change in the use of the pumping plants. Irrigators have claimed in previous utility sponsored pump programs that repairs have led to increased energy use[5]. Without changes to the length of irrigation intervals, or in the size of an irrigation set to reflect the new system capacities, overall water delivery tends to increase for a given size field. The increased water delivery is accomplished more efficiently, but nonetheless results in higher overall water and energy use, and increased electrical demand. Changes to system head pressure can also lead to higher pump energy use, even in the absence of an increase in seasonal water delivery to the field.

Pump testing for agricultural customers has been supported by California utilities for decades. Prior to the energy efficiency and DSM programs, pump testing and repair programs were

[5] Hanson, Blaine R., "Improving Pumping Plant Efficiency Does not Always Save Energy", California Agriculture, July-August, 2002, 123.

largely viewed as an economic tool to help farmers increase crop yields and quality, and were seen as a valuable service to the agricultural sector. Increases in energy use were seen as a slight negative when compared against higher revenues from increased yield and quality. There was and continues to be a significant positive economic impact to a grower when the pumping plant is operating at higher OPE.

Given the current environment, including relatively few water meters for measuring flow rates or total flow to a field, a low participation rate for time-of-use rates, and the reportedly common practice of neglecting to change irrigation schedules after pump repairs, it is unlikely that the best case condition of 47 MW of savings will be achieved.

The calculations for potential Category 2 demand savings suggest that potentially large savings could be achieved; however, these savings are not likely to occur without additional intervention to insure that additional volumes of water are not applied to a field. Nexant believes that economic incentives from higher crop yields or potentially improved quality are more likely to influence an irrigator's behavior than are increases in utility bills due to slightly higher energy use.

Nexant's post-retrofit evaluation of the sample of pump repair projects is based on a review of OPE tests, invoices for pump repairs, and billing data. Nexant does not believe that this approach will be sufficient to determine energy and peak period demand savings that have been achieved, except for pumps that are on time-of-use rates. A follow up study that investigates the change in irrigation practices and measures flow rates over a growing season after pump repairs would provide the data necessary to better estimate actual load savings from pump repair projects.

The post-installation projects identified for the sample of Category 3 projects have all been completed and paid in full by the administrators. Many of these projects were based on ISO contracts to deliver demand savings during emergency conditions. Two tests were conducted for a small number of the projects, however the projects have not been called on to shed load under real world conditions. Other projects within the Category 3 classification are based on Time of Use rates and advanced telemetry to enable load shifting. These projects can be expected to continue to deliver on peak demand savings continuing into the future. Demand savings from projects with ISO contracts are no longer under the original ISO contracts, and the demand savings are unavailable at this time.

No additional Category 4 projects have been accepted for grant contracts since the first quarter of 2002 and the overall population of approved projects has been reduced from the 2002 report. Of the 24 approved projects reported in the 2002 Report, only 20 are still in the program. All have now been completed and paid all incentives. Nexant has field-verified three of the projects, and the Fresno administrator has verified an additional six projects.

Onsite Energy Corporation has completed all of the projects proposed under their contract with the CEC. Each project was approved with a project specific M&V plan, and reports for the peak period demand savings have been reviewed and approved by Nexant. The M&V plan for each project was specific to the project and included a combination of pre-and post-installation monitoring, utility bill analysis, or engineering model(s). Onsite Energy Corporation staff engineers are responsible for most of the M&V activities but sub-contractors have completed some of the analysis and modeling work. As an example, Robert Mowris Associates provided an analysis of the utility billing and plant production at an existing tomato processing plant in Lodi as the baseline for a plant upgrade and relocation to Woodland.

In contrast to problems the Fresno administrator encountered with the Frito Lay, Bakersfield projects, the upgrade of the Pacific Coast Producers, one of Onsite Energy Corporations projects at a tomato production facility included a clear baseline and post-installation measurement approach outlined prior to pre-approval of the project. The PCP Woodland project presented other significant problems, including an expected increase in production relative to the existing Lodi facility. The problem of measuring demand savings for a large complex with increased production was resolved by normalizing savings results to the pre-retrofit production levels.

For Leprino foods, Onsite Energy Corporation was able to utilize post-installation monitored results for a previous refrigeration plant upgrade to establish a baseline for the refrigeration facility. Onsite continued to monitor compressors and other equipment in the engine room to develop the post-installation energy and demand. Energy savings were thus based on measured pre- and post-installation performance data.

Many of Onsite Energy Corporations projects included installation of a demand limiting system from Powerit Solutions. The Energy Director hardware does not typically result in significant energy savings, but results in large reductions in peak period demand charges that are based on a 15-minute moving average of facility demand. Energy savings may be minimal for these projects, and thus calculation of demand savings using the average peak period energy savings divided by the on-peak hours in the summer peak period results in very small improvements in the average demand savings. However, analysis of the pre- and post utility billing data reveals that similar to a category 3 type project, this technology lowers the maximum demand that a facility receives through relatively short term and minor control actions initiated through the hardware, and with a rule-based prioritization of equipment loads to control.

1.5.2 Realization Factors and Confidence/Precision Intervals

Realization rates for the administrator-reviewed projects are not available for most of the projects in the samples at this time. Nexant's desk-based review of Category 1 projects in the post-installation sample suggests that a preliminary realization rate for all Category 1 projects is approximately 76%. The realization rate is the rate of verified demand savings divided by the estimated demand savings for all projects in Category 1 and Category 3, plus projects from Onsite Energy Corporation.

Measurement and verification of project savings for Category 1 and Category 3 projects reviewed by the two administrators are not complete, but are substantially complete for reporting purposes. Final savings values are not available at this time, but can be expected to change very little. At the completion of the sample project analyses, all reported savings values contained an associated uncertainty. The "true" value of the demand reductions achieved is reported with an associated precision and confidence level. The precision represents the range of likely values and the confidence level indicates the probability that the true value is within this range. In this program, MV&E efforts were designed for a program element level precision of 20% at an 80% confidence level; in other words, the documented demand reduction has an 80% probability of being within ± 20 percent of the true value. These levels were chosen to balance the uncertainty with the MV&E costs; decreasing the uncertainty requires significantly more effort and cost.

1.6 PROGRAM ELEMENT COST EFFECTIVENESS

Table 1-11 lists the summary of cost-effectiveness indicators for projects approved by the two administrators and Onsite Energy Corporation. Final peak period savings have not been reported for a few of the projects, and final payments have not been made for a small fraction of the projects. However, due to the large population of projects that have been verified, approved, and paid, the overall calculations for cost-effectiveness are unlikely to change in any significant way.

Table 1-11 is based on contracted savings and corresponding grant payments for approved Onsite Energy Corporation, CIT, and ITRC projects. Levelized cost-effectiveness values were calculated individually for each project with Effective Useful Life values found in Appendix F of CADMAC protocols – Effective Useful Life Values for Major Energy Efficiency Measures[6].

Some of the energy efficiency measures described in the project applications are not shown in the CADMAC protocols. Nexant assigned a conservative 5-year useful life to all energy efficiency measures not listed in the report. For Category 3 projects that are also participating in the CAISO projects, the useful life of load shedding was assumed to be one (1) year, after which time payments cease.

Table 1-11: Project Cost – Effectiveness Summary

Project Category	Administrator Reported Demand Reduction, kW	Paid Grant Amount, ($)	Simple Cost Effectiveness, $/kW	Levelized Cost, $/kW-yr	Number of Projects	Average Grant Amount, ($)
1	27,320	4,382,470	$160.41	$21.55	193	$22,945
2	N/A	$4,049,558	N/A	N/A	747	$5,421
3	29,930	$1,003,514	$33.53	$17.72	18	$55,751
4	N/A	$1,633,048	N/A	N/A	20	$81,652
Onsite Energy Corporation	8,807[1]	$2,000,000	$250[1]	$54.00	43	$47,619
Totals[2]	66,057	$13,068,599	$199.65	$43.47	1021	$12,838

[1]Onsite Energy Corporation has contracted with the Energy Commission to deliver up to 8 MW of peak period demand savings at a price of $250 per kW. Onsite Energy Corporation projects are located at food processor facilities and are typically energy efficiency projects similar to Category 1 projects from the two independent administrators. Project savings above the 8MW contract may be moved to another program.

[6] EULs are available on the CALMAC website: http://www.calmac.org/cadmac-protocols.asp

[2]Totals shown include all projects in all project categories. Simple and levelized costs are calculated with no additional demand savings for Category 2 or Category 4 projects. Both Simple and Levelized costs are calculated with all savings reported by Onsite including savings in excess of 8MW contract limit.

Initial impressions of the final cost-effectiveness values are that Category 3 projects are the most effective projects for delivering peak period demand savings at a low cost, from both a simple and levelized cost-effectiveness basis. Category 1 projects have a relatively large simple cost-effectiveness value, but when calculated on a levelized cost-effectiveness basis, the average value drops by more than a factor of eight due to long useful lives for many of the measures.

Cost-effectiveness is not calculated for Category 2 projects since demand savings estimates from pump repair projects are not available. However, if the pump repair projects approved by the administrators all resulted in reductions in hours of operation during peak periods as discussed in Section 1.5.1, and if the reduced hours resulted in the maximum potential of 47 MW of peak period savings, the levelized cost for pump repair projects is calculated at $18.64/kW-yr for a pump retrofit that has a useful life of 5 years, and the average levelized cost-effectiveness value for all projects drops to $25.38 from the value of $43.47 shown in Table 1-11. Nexant is not suggesting that peak period savings for pump repairs completed under the APLRP are realistic at 47 MW; however, any peak period demand savings resulting from pump repairs or retrofits has a positive impact on overall program element cost-effectiveness indicators, both simple and levelized.

1.7 PROCESS EVALUATION

1.7.1 Audit Plan for Program Element

To gauge performance of the two administrators during the program, Nexant conducted surveys of participants identified in the post-installation sampling plan, and performed on-site interviews with the administrators. Administrator performance was measured in a qualitative manner by examining documentation related to the sample projects and the grant process. Nexant reviewed documents including project applications, billing data, engineering models, calculations of baseline demands, savings calculations and approved M&V plans. Nexant evaluated the timeliness of project reviews, notifications to participants, and the grant contract process. Nexant also noted the administrators' marketing efforts to the agriculture industry, including trade groups contacted, methods of disseminating program information to potential project applicants, and local or regional workshops.

Nexant's administrator audit was not intended to be a fiscal audit, but rather to get a sense of how well each administrator followed program element guidelines and what level of effort was expended to market the program to potential applicants and trade groups. Both administrators are nearing full subscription of incentive funding prior to the close of the program; therefore, they have—by definition—met the overall marketing goals.

Participant audits were also conducted for all sponsors of sample projects in each category. Participant audits previously developed for other program elements were modified as needed and used as a basis for determining overall satisfaction with the program, administrator actions related to each project, and to capture comments that may prove useful in future program design. Participants were contacted by phone for the audit, with answers recorded on forms for each participant that agreed to talk with Nexant about their project. Nexant also polled a number of participants who did not complete projects, or withdrew the project applications. The results of the participant surveys are presented in Section 1.7.4 below.

1.7.2 Audit Activities

Randy McCall and Jim Herndon, from Nexant, visited the Fresno administrator, Peter Canessa, PE, on December 4, 2002 to collect documentation on sample projects, and to conduct an interview regarding marketing activities and trade group contacts. Mr. Herndon presented the list of sample projects to Bob Hall, P.E, the new administrator for the program, while Mr. McCall interviewed Mr. Canessa, the original program administrator.

Mr. Herndon was assisted in retrieval of all requested files and documentation by Mr. Hall. Copies of all documents including billing histories, site maps, engineering studies and project applications were made on CIT's copier for future analysis and review for the audit. Mr. Herndon reported that all documentation was made available to Nexant, files were well organized and easy to find, and the staff were very helpful in completing his task.

During Mr. McCall's interview with Mr. Canessa, questions were asked and notes recorded related to marketing efforts that CIT had completed or were planning to do in the future to promote the program. Mr. Canessa was asked to provide details of trade group contacts, bill inserts to utilities, workshops that had been conducted, and trade shows that CIT attended.

Mr. Canessa was also queried on CIT's technical process for determining the merits of a project application, how a baseline demand was analyzed and adjusted, how potential savings would be measured and verified after installation, and how technical problems beyond the scope of CIT were handled. In all cases, Mr. Canessa provided detailed answers and discussion of the process CIT uses to review, approve, and contract a project; a description of the process is in the following section.

Mr. Dan Howes of ITRC was also contacted to schedule an interview. However, a visit could not be arranged prior to the end of the year. Mr. Howes indicated that a site visit by Nexant would not be a problem, and Nexant would be given access to project files to conduct a similar process that was completed at CIT. Nexant scheduled the interview with Mr. Howes early in the first quarter of 2003, and will also attempt to schedule an interview with ITRC's program manager, Charles Burt, Ph.D., PE.

The revised final report will include a formal presentation of audit results based on the administrator audit visit to ITRC and a follow-up interview with Bob Hall, the current administrator for CIT.

1.7.3 Evaluation of Administrator Audit Results

Nexant's interview with -Peter Canessa, PE, program manager for CIT's APLRP, was conducted in an informal setting, following an interview guideline to prompt questions about the process of running the program. Notes were recorded for responses to questions.

The interview began with a discussion of marketing of the program and how information was disseminated to the agricultural industry. Mr. Canessa responded that a range of approaches were used, including utility bill inserts to PG&E's agriculture accounts, seminars, trade shows, county fairs, the local Farm Bureau, and the internet with a CIT web site devoted to the program. Bill inserts were also sent to SCE and SMUD, although the dates were not recorded in the notes. The bill inserts were enclosed in PG&E utility bills during June 2001 and again later in the same summer.

Outreach efforts from CIT appeared to be consistent with a large, well-organized program, although participant audits may shed more light on issues related to learning about the program and program details. Nexant has noted that the web site for the Agricultural element of the PLPRP has been updated regularly throughout the program, and information was presented in a clear format with downloadable files in Word and Adobe Acrobat formats.

Once potential participants learned of the program and decided to move forward with a project, they were required to complete applications for projects and follow the program guidelines in the program descriptions found on the CIT's web site. Mr. Canessa explained that he often spent 20 to 30 percent of each day assisting customers in completing project applications. Services that Mr. Canessa claimed were available to applicants included technical assistance to an applicant once they had submitted a project application with a minimum of a basic project description. CIT, unlike ITRC, marketed to the larger community of agriculture, including smaller farmers and food processors not likely to have the engineering expertise of large water districts. Mr. Canessa indicated that he and staff members had conducted training sessions in the local area, as well as in the north valley at Brooks Ranch with slide shows and application advice provided to seminar participants. The trade shows and training sessions were reported to be infrequent, and a schedule of events was not provided during the interview.

Mr. Canessa or one of the CIT staff engineers generally performed the technical review of project applications. When a technology or proposed measure was outside of the expertise level of Mr. Canessa or the staff, consultants retained by CIT were asked to provide additional review for specific issues. Mr. Canessa described several projects and problems that had been encountered relating to poor documentation of operating conditions for baselines, how baselines were evaluated, and typical problems CIT had to solve. Typically, CIT used billing data to establish the baselines, although monitored data was required prior to baseline approval for a few of the projects.

Nexant's review of the project documentation and calculations showed a consistent approach to baseline determination and savings calculations. Measurement and verification for project savings was often based on a full summer peak period billing after project installation, but in some cases monitoring or spot measurements of equipment loads was also required. Nexant's review of the savings approved for Category 1 sample projects was consistent with CIT's methodology, and generally in agreement with savings totals. Only one project appeared to have a minor error in the calculation of savings.

Based on Nexant's interview with Mr. Canessa, and explanations of CIT's approach to marketing techniques, the technical expertise exhibited in project reviews, and follow-through on projects in a timely manner as detailed in progress reports, it is Nexant's opinion that CIT is administering the APLRP in a competent and consistent manner.

The revised final report will include a formal presentation of audit results based on the audit of the ITRC administrator and an additional visit to the CIT administrator. The revised final report will include detailed information about outreach efforts and documentation review of the sample projects.

1.7.4 Evaluation of Participant Surveys

This section summarizes the results of participant audits that were conducted of the Agricultural Peak Load Reduction program. A representative sample of 28 participating customers was surveyed in order to assess key qualitative aspects of program performance that extend beyond typical analyses of reported demand savings. All audit results are for the period of 2003 and were compiled based on participant responses to a set of 18 standardized survey questions.[7] Participant surveys consisted of a combination of closed- and open-ended questions covering such topics as the program application process, notification system, end-user involvement in similar programs, and level of satisfaction in different areas of program administration and implementation. For 11 out the 18 survey questions, participants were provided a numeric five-scale rating to evaluate their satisfaction with key program elements. Key results from the participant surveys are presented below.

1.7.5 Motivation to Participate in the Program

Each of the sample program participants was asked to state the main reason(s) for enrolling in the program. Table 1-12 lists the different responses that were received from end-users segmented by project category. The survey results reveal that participants were primarily motivated by a desire to reduce their energy costs and or get access to grant money to help subsidize investments in a range of efficiency related projects.

Table 1-12: Overview of Customer Motivation to Enroll in the Program

	Category 1 (n=6)	Category 2 (n=10)	Category 3 (n=5)	Category 4 (n=6)	**Total**
Contribute to solving the CA energy crisis (1)	2				2
Access to incentives and grant money(2)		7	2	1	10
Shift load to off-peak periods		1			

[7] A copy of the survey form is contained in Appendix for this report.

	Category 1 (n=6)	Category 2 (n=10)	Category 3 (n=5)	Category 4 (n=6)	**Total**
					1
Reduce energy costs/ achieve economic gain (3)	5	2	3	5	15
Efficient use of energy and water	1	1			1
Provide back-up				2	2

Notes: 1) two respondents noted their motivation was to both lower energy costs and reduce the state's energy burdens; 2) One respondent said their motivation was driven by both the receipt of a grant plus a desire to improve efficiency; 3) two respondents stated that they were motivated by a desire to avoid high gas costs as well as have a back-up source of energy.

Two respondents in Category 1 (energy efficiency projects) stated that they were motivated by the dual goals of saving money and helping minimize the statewide energy crisis. Category 2 customers were almost entirely driven by the ability to access grant money. For Category 4 (conversion to alternative fuels), the vast majority of respondents said their participation stemmed from a desire to avoid paying high natural gas prices.

1.7.6 Administrator Performance

Participant surveys also included a series of questions that used a numeric scale to assess the performance of program administrators. As noted in Section 1.1 the two main administrators for the Agricultural Peak Load Reduction program were the Center of Irrigation Technology (CIT) and the Irrigation Training and Research Center (ITRC). Table 1-13, shown below, provides a breakout of the survey sample by program administrator and project category.

Table 1-13: Breakout of Survey Sample by Administrator and Project Category

Administrator	Category 1	Category 2	Category 3	Category 4
CIT	6	5	4	6
ITRC	0	5	1	0

As illustrated in the table above, CIT accounts for virtually all of the survey respondents in Categories 1, 3, and 4. Further, even in Category 2, which contains an even mix of CIT and IRTC, survey results show little or no difference in responses from participants with different program administrators.[8] Therefore, survey results relating to program administrator performance are assumed to uniform across all project categories. Table 1-14, shown below, lists the average score for selected program administrator related questions on both an individual project category basis as well as for all categories (total sample population).

[8] See Appendices for more detailed results of the participant surveys.

Table 1-14 Program Administrator Results

Q4: On a scale of 1 to 5, rate the overall quality of the communication process with your administrator (5=complete/thorough; 3=sufficient/adequate; 1=absent/wholly inadequate)				
Category 1	**Category 2**	**Category 3**	**Category 4**	**ALL CATEGORIES**
4.3	4.6	4.6	4.5	4.5
Q6: On a scale of 1 to 5, rate the reasonableness of reporting requirements (5=Very reasonable; 3=Somewhat reasonable but some challenges; 1= completely unreasonable				
Category 1	**Category 2**	**Category 3**	**Category 4**	**ALL CATEGORIES**
3.8	4.1	4.2	4.8	4.2
Q14: How would you rate your administrator? (On a scale of 1 to 5; 1 being Unacceptable and 5 being Outstanding)				
Category 1	**Category 2**	**Category 3**	**Category 4**	**ALL CATEGORIES**
4.0	4.9	4.5	4.3	4.5

In general, customer responses indicate that participants (across all four projects categories) felt that the performance of their program administrator was strong and that program reporting requirements and communication procedures were very reasonable.

1.7.7 Administrator Performance

Participant surveys also included questions that were utilized to determine a customer's opinion of the overall program as well as to gage the effectiveness of key operational aspects. The remainder of this section details the results of participant audits relating to these two key areas.

1.7.9 Participant Opinion of the Program

The survey results (average score) listed below in Table 1-15 illustrates that participants had a positive experience with the Agricultural Peak Load Reduction program (Q #13) and would be willing to enroll in similar programs (Q#14).

Table 1-15 Participant Opinion of the Program

Q11: *Would have performed peak load-reducing actions without the program? Rating: 5=without question; 3=yes, but under different circumstances; 1=under no circumstances)*				
Category 1	**Category 2**	**Category 3**	**Category 4**	**ALL CATEGORIES**
3.2	2.6	2.2	2.5	2.6
Q12: Would you participate again in a similar program? Rating: 5=without question; 3=yes, though under different circumstances; 1=under no circumstances.				
Category 1	**Category 2**	**Category 3**	**Category 4**	**ALL CATEGORIES**
5.0	5.0	4.8	4.5	4.8
Q13: *How would you rate your experience with the Peak Load Reduction Program? (On a scale of 1 to 5; 1 being Unacceptable and 5 being Outstanding)*				
Category 1	**Category 2**	**Category 3**	**Category 4**	**ALL CATEGORIES**

4.3	4.5	3.8	4.3	4.3

Respondents from Categories 2, 3, and 4 indicated that they would not have likely performed peak load reduction action in absence of the program (Q#11). However, customers that implemented Category 1 projects stated that they would have reduced their load without the program's support—Category 1 results indicate that the inherent economic benefits of energy efficiency measures may already be sufficiently strong to mobilize investment in this sector.

1.7.10 Review of Program Operational Elements

Participants in the survey sample were asked a series of questions relating to key operational elements of the program. Specifically, participants were asked to rate an element of the program, on a scale of 1 to 5 (with 1 being Unacceptable and 5 being Outstanding). Participant responses across the different project categories, displayed below in Table 1-16, illustrate that end-users felt that the program operations were efficient and relatively smooth.

Table 1-16 Participant Reviews of Key Program Operational Elements

Category 1	Category 2	Category 3	Category 4	ALL CATEGORIES
Q15: *How would you rate the application process?*				
4.0	4.3	3.0	4.2	3.9
Q16: *How would you rate the invoicing, billing and payment process?*				
4.3	4.5	3.5	4.2	4.1
Q17: *How would you rate the verification process?*				
4.2	4.6	4.0	4.7	4.4
Q18: *How would you rate the implementation timeline that you were on?*				
4.2	4.5	4.3	4.4	4.4

The average response for all of the categories to each of the above questions was approximately 4 or higher, indicating a high level of customer satisfaction with the program's operations. However, it is important to note that customer responses in Category 3 (i.e., for Q#15 and #16) were slightly below other project categories. These results reflect in part that demand response is a relatively new (and more complex) type of project compared to more traditional energy efficiency and gas conversion measures.

1.8 CONCLUSIONS

1.8.1 Program Element Successes

The success of the Agricultural Peak Load Reduction Program should be considered in context. Agriculture in California is a $27 billion industry using 4 percent of the state's electricity. The agriculture industry is not concentrated in a few large facilities, but instead is made up of thousands of individual farms, dairies, orchards, and food processing facilities. The agriculture industry is a very diverse market segment employing over 4 percent of the state's workforce, and as such, programs directed at the broader market have always experienced difficulties in reaching all segments of the industry. Although a substantial fraction of the overall Peak Load Reduction

Program funded through AB970 and SB 5X/29-X, the $39.7 million allocation to the Agricultural Program is less than 0.16 percent of the value of the agriculture industry as a whole. Compared to the value of agriculture's annual production, incentives and funding for the program element are relatively minor.

But in spite of the modest funding relative to the overall size of the agriculture industry, the 1021 projects contracted by CIT, ITRC, and Onsite Energy Corporation, have achieved 65.5 MW of peak period load reductions for the State's electrical grid. The Peak Load Reduction Program was born under emergency conditions of 2000 / 2001 when, at times, 65.3 MW of capacity might have prevented or reduced the duration of rotating power outages.

What worked, and how well did it work? From a perspective of immediate response to emergency conditions, demand responsive projects were signed up, implemented, and tested within months of the program launch. ITRC contracted with water districts for 45.6 MW of peak period demand savings for a total incentive cost of $899,367. The final analysis shows that much of the estimated savings for the Category 3 projects administered by the ITRC were withdrawn or cancelled resulting in a total of 25.5 MW in potential load relief for ITRC Category 3 projects. The Fresno administrator was similarly successful, contracting for a total of 4,628 kW of peak period savings, with a verified amount of 4.4 MW and a contracted grant total of $104,147. The simple cost-effectiveness value for all Category 3 projects is $33.53/kW in contrast to the calculation for Category 1 projects averaged $160.41/kW on a simple cost basis. However, on a long term basis, the Category 1 projects provide consistent, long lived demand and energy savings that are reflected in the calculation of levelized cost-effectiveness at $21.55/kW-yr for Category 1 projects vs. $17.72/kW-yr for Category 3 projects.

The timeline for the Category 3 project submittals, approvals, and project completions is also of interest in terms of program element successes. In most cases, the projects were received, reviewed, approved, contracted, and constructed by the end of October 2001. This is a phenomenal response, even in light of the fact that many of the projects were also participating in the CAISO voluntary load reduction program. Nearly 30 months after program start-up, the 191 Category 1 electrical efficiency projects still have not achieved the peak period demand savings that 18 Category 3 projects achieved in the first six months. The comparison is somewhat unfair, as the Category 3 projects actually delivered *potential* peak period demand savings. But the speed and low cost for which these projects and savings were delivered is clearly important for the future of load management programs.

Program participants also jumped in early at the chance to diversify their fuel sources through Category 4 project incentives. The projects provided incentives to install equipment that would allow them, but not require them, to burn alternative fuels to natural gas. As this program was rolled out after price increases drove natural gas prices to the highest levels California had ever seen, the level of interest these incentives attracted early in the program is not surprising. Somewhat disappointing was the level of project withdrawals, and cancellation for alternative fuel conversion projects. Of the original 56 projects submitted to CIT, only 20 were approved for contracts, and have been completed with grant payments made. Clearly, the volatile pricing of natural gas and the dramatic drop in price in early 2002 was a factor for some participants in their decisions to abandon projects. With recent increases in the cost of natural gas, some of the early participants who later withdrew applications may be revisiting their decisions.

While participants with Category 1 electrical efficiency projects were not as swift to sign up for the program, there has been a steady increase in the number of approved projects leading to the current total of 191 approved projects. The two administrators contracted for a total of 27,910 kW in peak period demand savings, of which 27,320kW were verified by the administrators.

The program also appears to be encouraging innovation in the application of energy-saving technologies in the agricultural industry, as evidenced by the increasing diversity of projects in the administrators' portfolios.

A notable success for the program was the installation and commissioning of the dairy manure biogas digester and generation equipment at the Inland Empire Utility Agency's RP1 and RP5 water treatment facilities. The project resulted in one of only two awards of the Governors Environmental Leadership Award to Southern California groups. The award, presented in December 2002 to both the Inland Empire Utility Agency and the Milk Producers Council, recognized their collaboration on the Chino Basin Organics Management Strategy. Phase I of the plan has resulted in continuous generation of 0.75 MW, diversion of 225 tons/day of manure from local fields where it may have contributed to additional groundwater contamination, and improvements to local air quality by preventing the release of methane, ammonia and its decomposition byproducts at the dairies participating in the program.

Leadership demonstrated by the agency in piloting the projects could be rewarded in the near future with increased interest from other concentrated feed operations in California. As regulations governing the storage and disposition of the animal wastes are tightened at the local, state, and federal levels, projects combining energy production, and mitigation of environmental impacts are likely to be implemented in increasing numbers.

Other examples of the success of the program element are not as clear-cut, but include the large number of pump repairs completed with 747 individual pump repair projects. The pump repair projects are significant to the agriculture industry, especially as an economic benefit to irrigators for improved crop yields and profitability. Peak period demand savings may be an outcome of the $4 million in incentive money for improving the efficiency of pumping plants, but the answer to how much demand savings—if any—was achieved is far from clear.

Onsite Energy Corporation was very successful in meeting their contract goals of delivering 8 MW in peak period demand savings. To a large degree, their success is a result of their collaboration with Powerit Solutions, the company that manufactures the Energy Director line of load control hardware for limiting peak period demands for a facility. Unlike other electrical efficiency projects that Onsite Energy Corporation completed, the projects with demand limiting systems provided significant savings totals by integrating a load management device that was designed around the idea that minor control actions to large equipment can result in significant overall facility demand reductions from previous years. These rule based systems are capable of being tuned to be more aggressive with respect to limiting the overall facility demand, or less aggressive as the situation warrants.

A potential plus for demand limiting systems of this type is their capability to be integrated with future programs to provide Demand Responsiveness for a facility. Because of the design and implementation of the systems, large savings can be accomplished, often with minimal impacts on facility production.

1.8.2 Lessons Learned

The agricultural program had some clear elements of success, as well as elements where a critical review of the process points out lessons for design of future programs. While Nexant believes that improvements could have been made to the program, this is not a suggestion that some elements of the program failed to deliver the intended benefits to the state or the agriculture industry.

Pump repair projects for both administrators make up the largest group of projects approved for grant payments by virtue of the volume of projects; as a group they also received funding that was similar in amount to all projects approved for Category 1. With demand savings for pump repair projects nearly impossible to accurately document without additional follow-up study, the impact of the pump repair projects has primarily been to stimulate the market for repair services, pump testing, and to raise the awareness of irrigators to pumping problems and solutions.

What has been achieved for this allocation of funding? Undoubtedly irrigators have benefited economically from improved pumping plant efficiencies and increased delivery rates of water to fields and crops, resulting in improved yields and quality. However, as was described in Section 1.5, if irrigators increase the amount of water delivered to a field because they neglected to change irrigation schedules or increase irrigation set sizes given the improved flow rates of the newly repaired pumps, the average peak period electrical demand for pumps may actually increase, not decrease as intended. This suggests two areas of improvement for similar or future programs that may be useful: (1) measurement of pre-installation and post-retrofit energy use and water deliveries to intended targets, and (2) intervention with irrigators in the form of education and control systems such that irrigators modify their operations of the repaired pumps and avoid inadvertently increasing the amount of water pumped to a field after the pumping plant efficiency is improved.

When equipped with a time-of-use meter, an irrigator is perhaps more likely to change pumping schedules to avoid high peak period time of use rates. However, TOU meters are not universal for pumps, and alternative real time pricing programs are unavailable in California at this time. In the absence of such programs, education and installation of time controls for pumps might help to mitigate the potential for increased energy use from pump repairs and OPE improvements.

Category 4 project grants were intended to encourage participants to install equipment that would allow a switch to alternative fuels from natural gas. Initial response to the program element was strong, with natural gas prices still at a high level following the early part of 2001 with its record high pricing. By September 2002, 15 of the original 57 applicants had withdrawn their project applications, and the final tally of 20 projects that were completed shows that high level of dropouts, as well as non-compliance with the program guidelines for some projects. A review of natural gas prices from the Energy Information Administration shows that natural gas prices for Commercial and Industrial customers peaked in February and March of 2001, and gradually receded from nearly $14 per thousand cubic feet to less than $6 per thousand cubic feet in February 2002. Only one of the 15 projects that were withdrawn did so prior to the January 2002, an indication that these projects were a hedge against high natural gas prices.

Payments made to Category 4 project participants was approximately 25% less than the total grant payments made by each of the two administrators and Onsite Energy Corporation for all of the Category 1 projects. With only 20 approved projects out of a total 1018 projects approved by the two administrator and for Onsite Energy Corporation, the average grant payment at $81,652 is significantly larger than the size of the next largest payment per project for Category 3 advanced telemetry projects. With no demand savings attributed to fuel switching projects, relatively few agricultural customers participating in the program, and a requirement that the project only provide the opportunity to switch fuels, the question might be asked if this was the best use of limited funding for a peak period demand savings program. This category was not chosen by the Energy Commission, but was included in the SB 5X legislation. The Energy Commission is aware that no electricity peak reduction would occur from these projects.

The last note regarding lessons learned from the program element is related to calculation of post-installation demand and baseline demand for the projects. The two administrators evaluated project applications and approved projects without the benefit of pre-installation inspections to verify equipment loads, or operating conditions. While post-installation M&V was required for some projects, a lack of baseline verification can often lead to errors in savings that are difficult to quantify or even recognize. Projects involving large facilities with many loads on a single utility meter are often where these types of problems occur. When only a small portion of an overall electrical billing is to be offset by an efficiency project, and variability from month to month in the billing data is factored in, peak period demand savings based on differences in the utility bills also may be difficult to justify.

For some of the Category 1 projects, applicants provided nameplate data for calculating baseline loads of motors or other equipment without reporting load profiles for the equipment. The APLRP was required to be implemented in a very short time frame in response to emergency conditions in California, and baseline verification procedures were relaxed in response to the urgency of the situation. However, the lack of good baseline information can easily lead to large errors in demand savings for a given project. Once the proposed equipment is installed, opportunities to verify baseline conditions are gone, and errors in reported savings are not likely to be discovered. Nexant strongly recommends that baseline verification be considered as an integral part of any future programs of this type.

This report on the Agricultural element of the PLRP is Nexant's final report to the Energy Commission and contains the evaluation of the agricultural element of the PLRP. The overwhelming majority of the projects have been completed and verified by the administrators, and no significant changes to the overall level of savings, or cost-effectiveness calculations is expected.